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Contribution from the Bureau of Entomology, L. O. Howard, Chief.

COCKROACHES.

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CONTENTS.

INTRODUCTION.

Roaches are among the commonest and most offensive of the insects which frequent human habitations. They were well known to the ancients, who called them *lucifuga*, from their habit of always shunning the light. The common English name for them, or, more properly, for the common domestic English species, is "black beetle." In America this name has not been adopted to any extent for this insect, which was early introduced here, and the term "roach," or "cockroach," is the common appellation of all the domestic species. The little German roach, however, is very generally known as the "Croton bug," or "water bug," from its early association with the Croton waterworks system in New York City. The popular designations of this insect in Germany illustrate in an amusing way both sectional and racial prejudices. In north Germany these roaches are known as "Schwaben," a term which applies to the inhabitants of south Germany, and the latter section retaliates by calling them "Preussen," after the north Germans. In east Germany they are called "Russen," and in west Germany "Franzosen," the last two appellations

NOTE.—This bulletin is of special interest to housekeepers throughout the United States. It is a revision of Circular No. 51 of the Bureau of Entomology, U. S. Department of Agriculture.

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indicating a certain national antipathy to rival countries as well as a fanciful idea as to origin. Still other names are "Spanier," dating from the time of Charles V, and "Däne," from Denmark.

DISTRIBUTION AND HISTORY.

The roaches belong to a very extensive family, the Blattidæ, comparatively few of which, fortunately, have become domesticated. In temperate countries some four or five species are very common household pests, and a few occur wild in the woods; but they are essentially inhabitants of warm countries, and in the Tropics the house species are very numerous, and the wild species occur in great number and

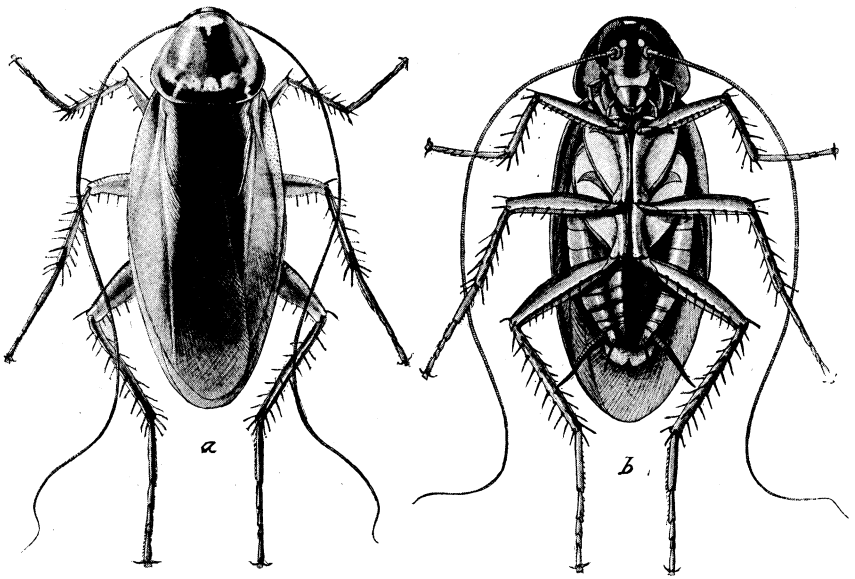

FIG. 1.—The American roach (*Periplaneta americana*): *a*, View from above; *b*, from beneath. Both enlarged one-third. (Author's illustration.)

variety, many of them being striking in shape, coloration, and size, one species expanding more than 6 inches. The inability of the domestic roaches to withstand unusual cold was illustrated by the fact that the severe weather in the winter of 1894 in Florida, which was so destructive to the citrus groves, on the authority of Mr. H. G. Hubbard destroyed all the roaches, even those in houses, except a few unusually well protected. Under suitable conditions in the more northern latitudes the domestic species often multiply prodigiously, and even in the far north a species occurs in the huts of the Laplanders, and sometimes entirely devours the stores of dried fish put away for winter consumption.

While the domestic species are few in number, nearly a thousand species of Blattidæ have been described and preserved in collections, and it is estimated that perhaps upward of 5,000 species occur at the present time in different parts of the world. The great majority of the roaches live outdoors, and in warm countries have the reputation of living on plants and sometimes being very injurious. This belief has been recently questioned by Mr. J. G. O. Tepper, of South Australia, who states that in his experience these insects are eminently carnivorous, feeding on caterpillars and other soft-bodied insects, and that with the increase of certain species in his gardens, notably *Epilampra notabilis*, "the herbivorous larvæ disappear rapidly." Mr. Tepper points out that the injury to plants occasionally noted where roaches are abundant may very possibly be due to other insects or to snails which again have attracted the roaches and on which the latter feed. That roaches will eat fruits and the starchy tubers and other products of plants is a common observation, but that they ever subsist on the green foliage of plants may be open to doubt.

The roach is one of the most primitive and ancient insects, in the sense of its early appearance on the globe, fossil remains of roaches occurring in abundance in the early coal formations, ages before the more common forms of insect life of the present day had begun to appear. The species now existing are few in number in comparison with the abundance of forms in the Carboniferous age, which might with propriety be called the age of cockroaches, the moisture and warmth of that distant period being alike favorable to plant growth and to the multiplication of this family of insects.

The house roaches of to-day were undoubtedly very early associated with man in his primitive dwellings, and through the agency of commerce have been carried to all quarters of the globe. On shipboard they are always especially numerous and troublesome, the moisture and heat of the vessels being particularly favorable to their development. It is supposed that the common oriental cockroach, or so-called "black beetle," of Europe [1] is of Asiatic origin, and it is thought to have been introduced into Europe in the last two or three hundred years. The original home of this and the other common European species [2] is, however, obscure, and in point of fact they have probably both been associated with man from the earliest times, and naturally would come into the newly settled portions of Europe from the older civilizations of Asia and Egypt.

Of the other two domestic species especially considered in this paper, the Australian roach,[3] as its name implies, is a native of Australia, and the American roach,[4] of subtropical and tropical America.

[1] *Blatta orientalis* L.
[2] *Blattella germanica* L.
[3] *Periplaneta australasiæ* Fab.
[4] *Periplaneta americana* L.

Rarely do two of the domestic species occur in any numbers together in the same house. Often also of two neighboring districts one may be infested with one species, while in the other a distinct species is the commoner one. The different species are thus seemingly somewhat antagonistic, and it is even supposed that they may prey upon one another, the less numerous species being often driven out.

STRUCTURAL CHARACTERISTICS.

Although among the oldest insects geologically, roaches have not departed notably from the early types, and form one of the most persistent groups among insects. The house species are rather uniformly dark brown or dark colored, a coloration which corresponds with their habit of concealment during daylight. They are smooth and slippery insects, and in shape broad and flattened. The head is inflexed under the body, so that the mouth parts are directed backward and the eyes directed downward, conforming with their groveling habits. The antennæ are very long and slender, often having upward of 100 joints. The males usually have two pairs of wings, the outer ones somewhat coriaceous and the inner ones more membranous and folded once longitudinally. In some species, as, for instance, the black beetle, the females are nearly wingless. The legs are long and powerful and armed with numerous strong bristles or spines. The mouth parts are well developed and have strong biting jaws, enabling these insects to eat all sorts of substances.

HABITS.

In houses roaches are particularly abundant in pantries and kitchens, especially in the neighborhood of fireplaces, on account of the heat. For the same reason they are often abundant in the oven rooms of bakeries or wherever the temperature is maintained above the normal. They conceal themselves during the day behind baseboards, furniture, or wherever security and partial protection from the light are afforded. Their very flat, thin bodies enable them to squeeze themselves into small cracks or spaces where their presence would not be suspected and where they are out of the reach of enemies. Unless routed out by the moving of furniture or disturbed in their hiding places, they are rarely seen, and if so discovered, make off with wonderful celerity, with a scurrying, nervous gait, and usually are able to elude all efforts at their capture or destruction. It may often happen that their presence, at least in the abundance in which they occur, is hardly realized by the housekeeper unless they are surprised in their midnight feasts. Coming into a kitchen or pantry suddenly, a sound of the rustling of numerous objects will come to the ear, and if a light be introduced, often the floor or shelves will be seen covered with scurrying roaches hastening to places of concealment. In districts

where the large American roach occurs they sometimes swarm in this way at night in such numbers that upon entering a small room in which they are congregated one will be repeatedly struck and scratched on the face and hands by the insects in their frantic flight to gain concealment.

The black roach is less active and wary than the others, and particularly the German roach, which is especially agile and shy.

The domestic roaches are practically omnivorous, feeding on almost any dead animal matter, cereal products, and food materials of all sorts. They are also said to eat their own cast skins and egg cases, and it is supposed that they will attack other species of roaches, or are, perhaps, occasionally cannibalistic. They will also eat or gnaw woolens, leather (as of shoes or furniture), and frequently are the cause of extensive damage to the cloth and leather bindings of books in libraries and publishing houses. The sizing or paste used on the cloth covers and in the binding of books is very attractive to them. The surface of the covers of cloth-bound books is often much scraped and disfigured, particularly by the German cockroach,[1] and the gold lettering is sometimes eaten off to get at the albumen paste. On shipboard the damage is often very extensive on account of the vast numbers of cockroaches which frequently occur there, and there are reliable accounts of entire supplies of ship biscuits having been eaten or ruined by roaches.

The damage they do is not only in the products actually consumed, but in the soiling and rendering nauseous of everything with which they come in contact. They leave, wherever they occur in any numbers, a fetid, nauseous odor, well known as the "roachy" odor, which is persistent and can not be removed from shelves and dishes without washing with soap and boiling water. Food supplies so tainted are beyond redemption. This odor comes partly from the excrement, but chiefly from a dark-colored fluid exuded from the mouth of the insect, with which it stains its runways, and also in part, doubtless, from the scent glands, which occur on the bodies of both sexes between certain segments of the abdomen, and which secrete an oily liquid possessing a very characteristic and disagreeable odor. It frequently happens that shelves on which dishes are placed become impregnated with this roachy odor, and this is imparted to and retained by dishes to such an extent that everything served in them, particularly liquids, as coffee or tea, will be noticed to have a peculiar, disgusting, foreign taste and odor, the source of which may be a puzzle, and will naturally be supposed to come from the food rather than from the dish.

The roaches are normally scavengers in habit and may at times be of actual service in this direction by eating up and removing any dead animal material.

[1] *Blattella germanica L.*

One other redeeming trait has been recorded of them, namely, that they will prey upon that other grievous pest of houses which are not subjected to careful supervision, the bedbug. Their habits in this direction have been recorded several times. One writer, in a narrative of a voyage,[1] makes the following statement in this connection:

> Cockroaches, those nuisances to ships, are plentiful at St. Helena, and yet, bad as they are, they are more endurable than bugs. Previous to our arrival here in the *Chanticleer*, we had suffered great inconvenience from the latter, but the cockroaches no sooner made their appearance than the bugs entirely disappeared. The fact is that the cockroach preys upon them and leaves no sign or vestige of where they have been; so far it is a most valuable insect.[2]

The cockroach is, however, far too much of a nuisance itself to warrant its being recommended as a means of eradicating even the much more disagreeable insect referred to.[3]

The local spread of roaches from house to house is undoubtedly often effected by their introduction with supplies, furniture, goods, etc. That the Croton bug, or German roach, and probably the other species also, may develop a migratory instinct has been witnessed by Dr. Howard and the writer in Washington.[4] This very interesting instance of what seems to have been a true migration, in which an army of thousands of roaches by one common impulse abandoned their old quarters and started on a search for a more favorable location, illustrates, as pointed out by Dr. Howard, what is probably of frequent occurrence under the cover of darkness, and accounts for the way in which new houses frequently become suddenly overrun with these vermin.

TRANSFORMATION.

The roach in its different stages from egg to adult shows comparatively little variation in appearance or habits. The young are very much like the adults, except in point of size and in lacking wings, if the latter be winged in the adult state. In their mode of oviposition

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[1] Foster, Henry. Narrative of a voyage to the Southern Atlantic Ocean in the years 1828, 29, 30, v. 1, p. 373–374, London, 1834.

[2] Proc. Ent. Soc. Lond., 1855, n. s. v. 3, p. 77.

[3] The following interesting letter from Mr. Herbert H. Smith, the collector and naturalist, gives a vivid picture of the roach nuisance in the Topics:

Cockroaches are so common in Brazilian country houses that nobody pays any attention to them. They have an unpleasant way of getting into provision boxes, and they deface books, shoes, and sometimes clothing. Where wall paper is used they soon eat it off in unsightly patches, no doubt seeking the paste beneath. But at Corumba, on the upper Paraguay, I came across the cockroach in a new rôle. In the house where we were staying there were nearly a dozen children, and everyone of them had their eyelashes more or less eaten off by cockroaches—a large brown species, one of the commonest kind throughout Brazil. The eyelashes were bitten off irregularly, in some cases quite close to the lid. Like most Brazilians, these children had very long, black eyelashes, and their appearance thus defaced was odd enough. The trouble was confined to children, I suppose because they are heavy sleepers and do not disturb the insects at work. My wife and I sometimes brushed cockroaches from our faces at night, but thought nothing more of the matter. The roaches also bite off bits of the toenails. Brazilians very properly encourage the large house spiders, because they tend to rid the house of other insect pests.

[4] U. S. Dept. Agr., Div. Ent., Insect Life, v. 7, no. 4, p. 349, March, 1895.

they present, however, a very anomalous and peculiar habit. The eggs, instead of being deposited separately, as with most other insects, are brought together within the abdomen of the mother into a hard, horny pod or capsule which often nearly fills the body of the parent. This capsule contains a considerable number of eggs, the number varying in the different species, arranged in two rows, the position of the eggs being indicated on the exterior of the capsule by transverse lateral impressions. When fully formed and charged with eggs the capsule is often partly extruded from the female abdomen and retained in this position sometimes for weeks, or until the young larvæ are ready to emerge. The capsule is oval, elongate, or somewhat bean shaped, and one of its edges is usually serrate. The young are in some instances assisted to escape by the parent, who with her feet aids in splitting the capsule on the serrate edge to facilitate their exit. On hatching, it is said the young are often kept together by the parent and brooded over and cared for, and at least a colony of young will usually be found associated with one or two older individuals. These insects are more or less gregarious, notably so in the case of the black beetle of Europe and to a less extent with the German and American roaches.

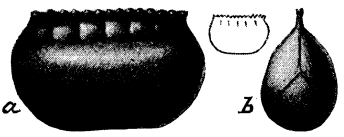

FIG. 2.—Egg capsule of *Periplaneta americana:* *a*, Side; *b*, end view. Natural size indicated by outline figure. (Author's illustration.)

They pass through a variable number of molts, sometimes as many as seven, the skin splitting along the back and the insects coming out white, soft, but rapidly hardening and assuming the normal color. Some astounding statements have been made as to the length of time required for the development of the roach from the egg to the adult. Four or five years have been said to be necessary for an individual to reach full growth; but more recent breeding experiments have not altogether confirmed these statements. Their development, however, is unquestionably slow, and probably under the most favorable conditions rarely is more than one generation per year produced. In colder countries the breeding and growth are practically restricted to the warm season. During the winter months they go into concealment and partial hibernation. *Blattella germanica* has been shown to reach full growth in a variable period of from four and a half to six months.[1] The common American roach [2] has been carried from the egg to the adult state in the insectary. Young hatching July 11 from an egg case received from Eagle Pass, Tex., reached the adult stage between March 14 and June 12 of the following year, indicating a period of nearly 12 months for complete development. The rate of growth of the roach undoubtedly depends

[1] Hummel, Essais Entomologiques, No. 1, St. Petersburg, 1821. [2] *Periplaneta americana* L.

very largely on food and temperature, and under unfavorable conditions the time required for development may undoubtedly be vastly lengthened. The abundance of roaches is, therefore, apparently not accounted for so much by their rapidity of multiplication as by their unusual ability to preserve themselves from ordinary means of destruction and by the scarcity of natural enemies.

THE COMMON DOMESTIC ROACHES.

The four roaches which have been made the subject of illustrations represent the species which occur most commonly in houses, bakeries, or on shipboard. The numerous tropical house species, many of which are perhaps only partially domesticated, and the subarctic roach of high altitudes and of the extreme north have been omitted.

The American roach [1] (fig. 1) is the native or indigenous species of this continent, originating, it is supposed, in tropical or subtropical America.

An ancient and rather quaint account of the American roach indicates that this species early came to the notice of our forefathers.[2] Its domesticity doubtless resulted from ages of association with the aborigines. It has now become thoroughly cosmopolitan and is unquestionably the most injurious and annoying of the species occurring on vessels. It is sometimes numerous also in greenhouses, causing considerable injury to tender plants. It is a notorious house pest and occasionally vies with the German roach in its injuries to book bindings. One of the most serious cases of injury of this sort was reported by the Treasury Department. The backs of both cloth and leather bound books were sometimes entirely eaten off to get at the starchy paste used in the binding.[3]

This roach is very abundant in the Middle and Western States, where until recently it has been practically the only troublesome house species. In the East it is not often so common as are one or other of the following species, and especially *germanica*. In foreign countries it has not become widespread and is largely confined to seaport towns. In size it is larger than any of the other domestic species, and it is light brown in color, the wings being usually long, powerful, and well developed in both sexes.

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[1] *Periplaneta americana* L.

[2] *The cockroach.*—These are very troublesome and destructive vermin, and are so numerous and voracious that it is impossible to keep victuals of any kind from being devoured by them without close covering. They are flat, and so thin that few chests or boxes can exclude them. They eat not only leather, parchment, and woolen, but linen and paper. They disappear in winter and appear most numerous in the hottest days in summer. It is at night they commit their depredations, and bite people in their beds, especially children's fingers that are greasy. They lay innumerable eggs, creeping into the holes of old walls and rubbish, where they lie torpid all the winter. Some have wings and others are without—perhaps of different sexes.—Catesby, Mark. Natural history of Carolina, Florida, and the Bahama Islands, v. 2, Appendix, p. 10, London, 1748.

[3] U. S. Dept. Agr., Div. Ent., Insect Life, v. 1, no. 3, p. 67–70, September, 1888.

The Australian roach[1] (fig. 3) resembles very closely the last species, but differs strikingly in the brighter and more definitely limited yellow band on the prothorax and in the yellow dash on the sides of the upper wings. In the United States it is the most abundant and troublesome species in Florida and some of the other Southern States. It is already practically cosmopolitan.

The oriental cockroach, or "black beetle,"[2] is the common European and particularly the English species, and is notable for the fact that the female is nearly wingless in the adult state. The wings of the male also are shortened, not reaching to the extremity of the body.

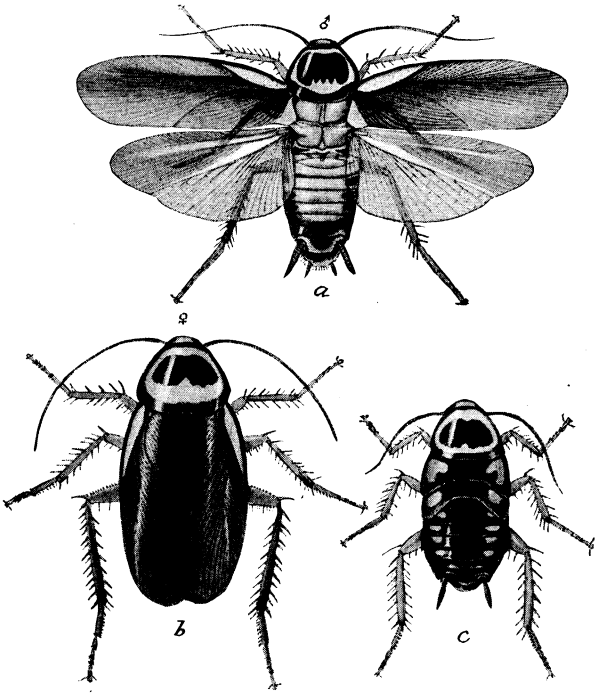

FIG. 3.—The Australian roach (*Periplaneta australasiæ*): *a*, Male with spread wings; *b*, female; *c*, pupa. All life size. (Author's illustration.)

In color it is very dark brown, almost black, shining, and rather robust, much stouter than the other species, making its English name of "black beetle" quite appropriate. This species is notably gregarious in habit, individuals living together in colonies in the most amicable way, the small ones being allowed by the larger ones to sit on them, run over them, and nestle beneath them without any resentment being shown. This species was a common and troublesome pest in the British colonies early in the eighteenth century, although unknown at the same time in the French Canadian possessions.[3]

[1] *Periplaneta australasiæ* Fab.

[2] *Blatta orientalis* L.

[3] Kalm, Peter. Travels into North America, ed. 2, v. 1, p. 321–323; v. 2, p. 256. London, 1772.

It then seemed to be commonly known as the mill beetle. The early Dutch called them *Kakerlach*, and in the Swede settlements they were known as *Brodætare* (bread eaters). It is now very common in houses in the East, but is quite generally distributed, and is the common species even so far removed from the Atlantic seaboard as New Mexico. The characteristics of this insect are shown in the accompanying illustration (fig. 4).

The German cockroach [1] is particularly abundant in Germany and neighboring European countries, but, like most of the other domestic species, has become world-wide in distribution. In this country it is very often styled the Croton bug, this designation coming from the fact, already alluded to, that attention was first permanently

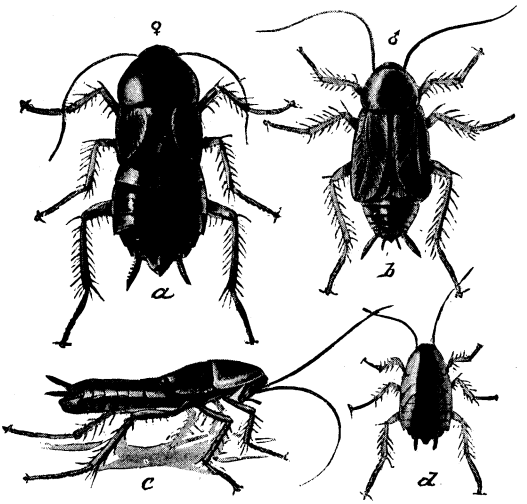

FIG. 4.—The Oriental roach (*Blatta orientalis*): *a*, Female; *b*, male; *c*, side view of female; *d*, half-grown specimen. All natural size. (Author's illustration.)

drawn to it at the time of the completion of the Croton system of waterworks in New York City. It had probably been introduced long previously, but the extension of the waterworks system and of piping afforded it means of ingress into residences and greatly encouraged its spread and facilitated its multiplication. The dampness of water pipes is favorable to it, and it may be carried by the pressure of the water long distances through the pipes without injury. This roach has so multipled in the eastern United States that it has now become the commonest and best known of the domestic species, and its injuries to food products, books, etc., and the disgusting results of its presence in pantries, storehouses, and bakeries give it really a greater economic importance than any of the other species.

[1] *Blattella germanica* L.

It is very light brown in color, and characteristically marked on the thorax with two dark-brown stripes. It is more active and wary than the larger species and much more difficult to eradicate. It is the smallest of the domestic species, rarely exceeding five-eighths of an inch in length, and multiplies much more rapidly than the others, the breeding period being shorter and the number of eggs in the capsules greater than with the larger roaches. The injuries effected by it to cloth-bound reports have been the source of very considerable annoyance at the Department of Agriculture and in the large libraries of

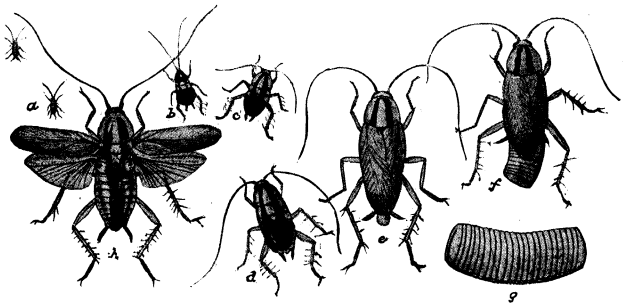

FIG. 5.—The German roach (*Blattella germanica*): *a*, First stage; *b*, second stage; *c*, third stage; *d*, fourth stage; *e*, adult; *f*, adult female with egg case; *g*, egg case, enlarged; *h*, adult with wings spread. All natural size except *g*. (From Riley.)

eastern towns and colleges. The characteristics of the different stages, from the egg to the adult, are shown in the illustration (fig. 5).

NATURAL ENEMIES AND PARASITES.

In Europe the egg capsules of the cockroach are often parasitized by an ichneumon fly.[1] This insect has become widely distributed over the world following its host insect, and has been redescribed under a great many different names. It was found in Cuba as early as 1829, and has been several times collected in the United States. Unfortunately, its usefulness as a means of keeping the roach in check by destroying the egg capsules is greatly impaired by the occurrence of another ichneumon fly,[2] which is parasitic upon the first. This is also a European species which has been brought over with its host parasite. If the true egg-capsule parasite of the roach could have been introduced into this country without this secondary parasite its usefulness would doubtless have been very much greater. The secondary parasite, however, seems to have been introduced early, and has been found in Cuba and Florida, and probably occurs as widely as its host and prevents the latter from multiplying very greatly. Among other natural enemies of the roach are tree frogs; and a correspondent informs us that if these animals are inclosed in a room overnight they will effectively clear it of roaches.

[1] *Evania appendigaster* L.

[2] *Entedon hagenowi* Ratzb.

REMEDIES.

Like the crows among birds, the roaches among insects are apparently unusually well endowed with the ability to guard themselves against enemies, displaying great intelligence in keeping out of the way of the irate housekeeper and in avoiding food or other substances which have been doctored with poison for their benefit. Their keenness in this direction may be the accumulated inheritance of many centuries during which the hand of man has ever been raised against them. Roaches may be controlled by the use of (1) poisons and repellents; (2) fumigants; and (3) trapping.

POISONS AND REPELLENTS.

As just noted, roaches often seem to display a knowledge of the presence of poisons in food, and, notwithstanding their practically omnivorous habits, a very little arsenic in baits seems to be readily detected by them. In attempting to eradicate roaches from the department storerooms where cloth-bound books are kept various paste mixtures containing arsenic were tried, but the roaches invariably refused to feed on them in the least. This applies particularly to the German roach, or Croton bug, and may not hold so strongly with the less wary and perhaps less intelligent larger roaches.

Sodium fluorid.—One of the most effective simple means of ridding premises of roaches is dusting with commercial sodium fluorid, either pure or diluted one-half with some inert substance such as powdered gypsum or flour. Numerous practical tests conducted in lunch rooms, bakeries, milk-bottle exchanges, etc., in Washington by Messrs. E. W. Scott, W. S. Abbott, and W. H. Sill, working under the direction of Mr. A. L. Quaintance, of the Bureau of Entomology of this department, have shown that with the use of this substance roaches can be completely exterminated with very little trouble and cost and with none of the possible dangers which attend the use of hydrocyanic-acid gas, another efficient control method referred to below under the subject of fumigation. With the use of some dust gun or blower the sodium fluorid can be thoroughly dusted over the shelves, tables, floors, and the runways and hiding places of the roaches. The immediate effect is to cause these insects to come out of their retreats and rush about more or less blindly, showing evidence of discomfort, to be eventually followed in the course of a few hours by their death. These dead or paralyzed roaches can be swept up and burned, and complete extermination is effected within 24 hours. It is not definitely known whether the sodium fluorid acts as a contact insecticide through the breathing pores or as a stomach poison. Probably, however, it acts in both ways, inasmuch as it has been found to kill caterpillars fed on foliage dusted with this substance.

Borax.—Powdered borax enters into the composition of many of the so-called roach powders. This substance may be used either pure as a poison or repellent or mixed with some other substance to render it attractive to the insects. Several correspondents have reported great success from the use of a mixture consisting of 1 part powdered borax to 3 parts of finely pulverized chocolate, this mixture to be freely sprinkled about the infested premises.

Pyrethrum.—Another common remedy consists in the liberal use of pyrethrum powder or buhach. This is at best but a temporary expedient, but if persisted in considerable relief will be gained. To be at all effective it must be fresh and liberally applied. The roaches are often paralyzed by it rather than killed outright, and the morning after the application all paralyzed and dead roaches should be swept up and burned.

Sulphur.—Flowers of sulphur dusted about where roaches abound has also proved, on the authority of Mr. A. I. Mudd, of this department, very effective as a repellent.

Phosphorus.—Of the proprietary substances, perhaps one of the oldest and most efficient is a form of phosphorus paste. It consists of sweetened flour paste containing 1 to 2 per cent of phosphorus, and may be distributed on bits of paper or cardboard placed in the runways of the roaches. It has been used very successfully in the offices of this department to free desks from Croton bugs, numbers of dead insects being found in the drawers every day during the time the poison was kept about. It also has some repellent value.

FUMIGANTS.

Hydrocyanic-acid gas.—Hydrocyanic-acid gas fumigation is a thoroughly effective means of ridding premises of roaches, but involves considerable cost, difficulty of application, and the necessity of taking extreme precautions on account of the deadly nature of the gas to higher animals, including human beings. A special publication, which may be had on application, has been issued by the Department of Agriculture giving the steps of the process in detail.

Carbon bisulphid.—Wherever roaches infest small rooms or apartments which may be sealed up nearly air-tight, and also on shipboard, the roach nuisance can be greatly abated by the proper use of carbon bisulphid. This substance, distributed about a pantry or room in open vessels, will evaporate, and, if used at the rate of 1 pound to every 1,000 cubic feet of room space, will destroy roaches. Unless the room can be very tightly sealed up, however, the vapor dissipates so rapidly that its effect will be lost before the roaches are killed. The hatches of ships, especially of smaller coasting vessels, may be battened down, a very liberal application of carbon bisulphid having been previously made throughout the interior. If left for 24 hours

the roaches and all other vermin will unquestionably have been destroyed. *In the use of this substance it must be always borne in mind that it is violently explosive in the presence of fire, and every possible precaution should be taken to see that no fire is in or about the premises during the treatment.* It is also deadly to higher animals, and compartments should be thoroughly aired after fumigation.

Pyrethrum fumes.—A safer remedy of the same nature consists in burning pyrethrum in the infested apartment. The smoke and vapors generated by the burning of this insecticide are often more effective in destroying roaches than the application of the substance in the ordinary way as a powder. There is no attendant danger of explosion, and the only precaution necessary is to see that the room is kept tightly closed for from 6 to 12 hours.

TRAPPING.

Various forms of traps have been very successfully employed in England and on the Continent of Europe as a means of collecting and destroying roaches. These devices are all so constructed that the roaches may easily get into them and can not afterwards escape. The destruction of the roaches is effected either by the liquid into which they fall or by dousing them with hot water. A few of the common forms of traps and the methods of using them are here described.

A French trap consists of a box containing an attractive bait, the cover of which is replaced by four glass plates inclined toward the center. The roaches fall from the covering glasses into the box and are unable to escape. A similar trap used in England is described by Westwood. It consists of a small wooden box in which a circular hole is cut in the top and fitted with a glass ring, so that it is impossible for the roaches to escape. This trap is baited nightly, and the catch thrown each morning into boiling water.

A simpler form of trap, which the late F. C. Pratt reported as being very successfully used in London, England, consists of any deep vessel or jar, against which a number of sticks are placed, and bent over so that they project into the interior of the vessel for a few inches. The vessel is partially filled with stale beer or ale, a liquid for which roaches seem to have a special fondness. In the morning these vessels are found charged with great quantities of dead and dying roaches, which have climbed up the inclined sticks and slipped off into the vessel. This last method has given fairly successful results against the Oriental roach in Washington, but against the more wary and active Croton bug it is comparatively worthless.

A simple and practical method of trapping roaches in large numbers was devised by a correspondent in Brockton, Mass. He took several tin bread pans with nearly vertical sides about 3 inches in height,

greased the bottoms and sides with a little rancid butter, and placed them where the roaches were numerous. Each pan in the morning contained hundreds of the pests unable to climb out because of the greased sides. The roaches were shaken out into hot water, and the pans were again ready for use, without regreasing.

Traps of the sort described above, placed in pantries and bakeries, will unquestionably destroy great quantities of roaches, and keep them in check and thus obviate the use of insect powders or the distribution of poisoned baits.

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